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"Positioning system for data acquisition"

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DESCRIPTION

The present invention refers to a positioning system, in particular for acquiring Georadar type data, and more particularly of the 3-dimension type.

The laying of the new technological networks (optical fibers) and the new lines for conveying electricity is based on no-dig or trenchless technologies. This technology is characterized by the possibility of laying the plants without having to dig a trench. A remote-control drill drags the cable along a preset path. The intensive laying of cables and tubes in the first meters underground and the lack of maps of the technological plants quite often make surveys necessary prior to the laying phases.

The Georadar surveys are up to now the only ones capable of identifying any technological plant or construction present underground.

During the laying of a cable without digging a trench the more dangerous portions of the trench are the drill immersion and surfacing areas, that have a plan extension of about 4m * 4m for a depth of a few meters, where the majority of the subservices can be found. The drill is immersed to the preset depth and then advances horizontally parallel to the plane of the ground.

In addition, this laying technique is suggested for laying the new technological networks (Directive dated 3 March 1999 art.5).

The geophysical radar or Georadar uses the reflection of electromagnetic waves for exploring underground. The technique is based on the insertion in the ground, by means of a transmitting antenna, of electromagnetic waves with extremely brief impulses (a few nanoseconds), whose central frequency is between 10 and 2000 MHz. The signal reflected from the surfaces of discontinuity present underground is received by a receiving antenna and recorded after sampling at suitable frequency. This type of survey enables high resolution measurements to be carried out with

ATTACHMENT "B"

graphic return of an underground continual section (time-distance) in real time

To analyse an area of ground the transmission and reception antennas have to be passed over the entire area concerned. The depth to be surveyed and the resolution required are determined through the choice of the antenna. High frequency antennas have good resolution but low penetration. To conduct Georadar surveys to locate the subservices the resolution needed is a few centimeters and the survey depth required is a few meters. Antennas with a frequency of the central band around 400 MHz are generally used.

The processing of the data received can be made by means of a bidimensional analysis, supplying in output the data relating to the various vertical planes analyzed. It can also be made by means of a three-dimension analysis. For three-dimension analyses the data received have to meet the theorem of the spatial sampling. In addition, good contact has to be kept and therefore good coupling between the ground and the antenna, as if there is air between the antenna and the ground the quality of the data deteriorates because of the reduced penetration of the signals.

Normally, for acquiring data the lines that will indicate the path that the antennas will have to follow are traced on the portion of ground to be analyzed, by means of paint or chalk, or theodolites are used.

In addition, the majority of times the Georadar surveys have to be carried out in heavily urbanized areas where it is very difficult to interrupt the traffic of vehicles, pedestrians or commercial activities. Therefore they are operations that have to be carried out quickly minimizing as much as possible the disturbance to the road traffic and the surface activities.

In view of the state of the technique described, an object of the present invention is to provide a positioning system, in particular for achieving Georadar acquisitions that is simple to carry out and apply, low cost and enable data acquisition to be carried out rapidly and with precision.

In accordance with the present invention, this and other objects are

achieved by means of a positioning system for acquiring data by means of a data acquisition system comprising at least one antenna that is passed over a surface to be surveyed comprising: a plurality of guides side by side, that can be coupled to said surface; a structure comprising a surface having at least one guide that engages with said plurality of guides and suitable for being conducted along said plurality of guides, said structure comprises said at least one antenna of said data acquisition system.

Thanks to the present invention the most precise low cost data acquisition possible can be carried out. In addition it can be carried out in limited space and on irregular surfaces because of its innate flexibility. It is simple, reliable, has a very limited weight and is extremely easy to apply. It guarantees very good coupling between the antenna and the means surveyed because the antenna can follow any possible sinking.

In addition, the system presented herein can be applied and can be adapted to any Georadar acquisition system.

It can be used without interrupting the traffic of vehicles or pedestrians as its dimensions are small and it does not move even if a vehicle passes over it.

The characteristics and advantages of the present invention will appear evident from the following detailed description of an embodiment thereof, illustrated as non-limiting example in the enclosed drawings, in which:

Figure 1 represents a positioning system for carrying out Georadar acquisitions in accordance with the present invention, seen in axonometry;

Figure 2 represents a positioning system for carrying out Georadar acquisitions in accordance with the present invention, seen in profile;

Figure 3 represents a variant of a positioning system for carrying out Georadar acquisitions in accordance with the present invention, seen in profile.

The inventive idea of the present invention is based on the fact of arranging some guides on the means to be surveyed to use as tracks for the

movements of the Georadar antenna on the ground.

In Figure 1 which is an axonometric view and in Figure 2 that is a profile view of the positioning system for carrying out Georadar acquisitions in accordance with the present invention, the guides 10 are shown positioned on a supporting layer 11, all in the form of a mat 12 placed on top of a surface of a means surveyed 17.

A structure 13 for supporting the antenna Georadar (not shown) is placed on the mat 12. This structure 13 has some guides 14 provided on its lower surface, preferably at least two, that engage in the recesses 15 left by the guides 10 on the supporting layer 11. Only one guide can be enough if it is capable of ensuring alignment with the guides 10. The guides 10 are preferably positioned on the supporting layer 11 equally spaced out and parallel.

The structure 13, in particular its upper part, can be made in any manner to support and hold the transmission and reception system (not shown in the Figure) placed over it while the structure 13 is being pulled. In alternative the structure 13 can support even only one or more antennas connected to the system by means of suitable cables.

Once the Georadar antenna has been positioned over the structure 13 itself, it is pulled, with the structure 13, manually or mechanically, along the guides 10 to guarantee the area to be investigated is covered. Preferably, making unidirectional, parallel and progressive profiles. For example, starting from one corner of the mat 12 and running along the entire length of the guide. At the end of the guide the structure is moved with the antenna in the adjacent guide and the new guide is passed along. Adjacent guides can be passed along in the same direction or in the opposite direction.

The mat 12, with the guides 10, is preferably composed of a soft material, so that it can follow the unevenness of the ground, such as rubber, PVC, cardboard, etc.

In an embodiment of the present invention, with a working frequency

of 500 MHZ, (one antenna with the dimensions of about 60x30x21 cm.), a mat 12 with the dimensions of about 4x4 m having a height of about 0,3 mm, the distance D1 between two guides is about 5 cm, the height H of the guide is about 0,3 mm, the distance D2 of the guide is about 2,45 cm. The measurements of the guides 14 are the same as the guides 10 so that they can easily engage with each other. In this embodiment example the guides 14, 2.45 cm wide, engage in the recesses 15 with width of 2,55 mm.. Thus a clearance of 1 mm has been created between the guides 10 and the guides 15 so that the structure 13 can be easily pulled. According to the materials and the tolerances required the dimensions given above can vary according to specific needs.

Normally different working frequencies are used in accordance with the resolution and depth required for the surveys. For example frequencies used commonly are 125, 250, 500, 1000 MHz.

With the aim of limiting the number of mats 12 to the variation of the frequency the mat 12 can have the guides 10 with close pitch and dimensions such that they meet the sampling theorem for the higher frequency antenna. For acquisitions with lower frequency antenna the same mat is used but the number of parallel profiles to be carried out is reduced passing along profiles spaced out between each other according to multiples of the minimum distance that exists between two parallel guides. To reduce the passage errors between one passage and the other of the antenna the guides have been fitted with an identification for example with suitable colors so as to indicate the different steps for the different frequencies, or by means of suitable reference symbols.

The measurements of the guides are determined for the highest use frequency (lowest wavelength) and the guides 10 are highlighted that the structure 13 will have to use as reference for the lower frequencies, for example a color or a symbol for each frequency that can be utilized.

Preferably, to align the sections made by pulling the structure 13 and

in particular to facilitate the departure or the arrival (or both two) of the passage along the guides, the guides themselves have been provided with a stopping device 16 (only partly shown for simplicity, but can be extended for all the guides 10 and the corresponding cavities 15). This permits precise reference points to be achieved for the beginning and the end of the data acquisition. Alternatively a profile can be used as stopping device 16 for example a profile to apply to the extremity of the guides, a mechanical stop or any other retainer.

The supporting layer 11 (and the guides 10 and 14) preferably have a smooth upper surface so that the structure 13 can advance without problems and a lower abrasive or rough surface so that once the mat 12 has been placed on the ground it has no movements. As an alternative or in combination, the lower surface of the mat 12 can be provided with glue for greater adherence.

In addition, the guides 10 can also be directly fixed to the ground (for example with glue) with manual or mechanical systems without the presence or the need of the supporting layer 11.

Other variations to the above are possible for the adjustment to the specific working conditions and considering the different needs that can arise for example when the means surveyed is not a horizontal ground but a vertical wall.

In Figure 3 is represented a variant of the system in accordance with the present invention, seen in profile. The guides 10 and 14 have been described previously having a substantially rectangular shape, but can also be shaped differently, for example triangular, trapezoidal or with a sinusoidal movement. Advantageously, a sinusoidal movement is that of the corrugated type of cardboard, normally used for packaging. Thus a mat 12 can be created with a piece of corrugated cardboard, with the dimensions desired and as structure 13 another piece can be used, with the dimensions desired, to apply suitable directly or indirectly to the Georadar antenna. Or a

structure in a plastic material (more resistant) with the same shape as the cardboard.

The present invention born for Georadar acquisitions can naturally be used also for all those applications in which a structure has to follow particular references suitable spaced out, for example scanner, sounding, ultrasonic surveys, and other non-destructive surveys.

The positioning system in accordance with the present invention, guarantees the supply of data that enable a success of 98% to be reached during the calculation phase in determining the positioning of structures within the surveyed area.

The acquisition time is in addition reduced considerably (up to 1/5 - 1/6 in relation to the systems normally used), as the preparation of the area surveyed no longer has to be prepared for the following survey.